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Logistics Operations School  
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Training Command  
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AIM 5305

**STUDENT HANDOUT**

**REPAIR ALLISON TRANSMISSIONS**

**LEARNING OBJECTIVES**

**TERMINAL LEARNING OBJECTIVES:**

1. Given an Allison MT 654CR transmission, an Aidco test stand, required tools, shop supplies, repair parts, student handout, and TM 9-2320-272-34-1, per information contained in the references, repair the transmission. (5.3.5)
2. Given TM 9-2320-297-34 and partial statements, per information contained in the reference, complete the partial statements to describe the procedures used to perform repair functions peculiar to the Allison HT740-D transmission. (5.3.6)

**ENABLING LEARNING OBJECTIVES:**

1. Given an Allison MT 654CR transmission, the required tools, shop supplies, repair parts, and TM 9-2320-272-34-1, per information contained in the references:
  - a. disassemble the transmission, (5.3.5a)
  - b. inspect the disassembled components for serviceability, and (5.3.5b)
  - c. repair or replace the unserviceable components. (5.3.5c)
2. Given the control valve subassembly of the disassembled transmission, required tools, an Aidco 250 test stand, and student handout, per information contained in the reference, perform those tests and adjustments required to ascertain serviceability of the control valve assembly. (5.3.5d)
3. Given the components of a transmission assembly whose serviceability has been confirmed by inspection or attained by repair or replacement, the required tools, shop supplies, and TM 9-2320-272-34-1, per information

contained in the reference, assemble the transmission from serviceable components. (5.3.5e)

4. Given TM 9-2320-297-34 and partial statements, per information contained in the reference, complete the partial statements to describe the procedures used to:

- a. disassemble the Allison HT740-D transmission, (5.3.6a)
- b. inspect the transmission, (5.3.6b)
- c. repair or replace the unserviceable components, and (5.3.6c)
- d. assemble the transmission. (5.3.6d)

## **OUTLINE**

### **1. DESCRIPTION AND SPECIFICATIONS OF THE TRANSMISSION**

a. The unit is identified as the Model MT 654CR automatic transmission, and is manufactured by the Detroit Diesel Division of the General Motors Corporation of Indianapolis, Indiana.

b. Alpha-numeric designations are used to identify transmissions of various designs by the manufacturer. The Model MT 654CR is characterized as follows:

M } Indicates a planetary gear type automatic transmission  
T (medium truck).

6 - Indicates a series "600" transmission design.

5 - Specifies a five speed transmission.

4 - Identifies the torque converter multiplication ranges (series "400").

                    Indicates "close ratio." The term "close ratio," specifies  
C} that the comparative difference in size of the driving gear  
R in relation to the driven gears is nominal.

NOTE: Some transmissions are designated "DR" - "deep ratio," which provides a more extreme difference in comparative gear size.

c. Speed ranges of the MT 654CR transmission consist of five forward speeds and a reverse gear.

(1) The transmission provides for automatic upshifting and downshifting through all ranges except forward and reverse, which must be manually selected.

(2) Each gear may be individually selected by the selector which will facilitate a "hold condition" in that gear and prohibit automatic shifting above that gear.

d. A torque converter, driven by the engine flywheel bolted to the engine crankshaft flange, establishes a fluid coupling which transmits and multiplies the torque product from the engine to the transmission gearing system.

e. A lockup clutch located within the torque converter assembly energizes at a prescribed rpm, forming a direct drive from the engine to the turbine shaft, thereby eliminating any possible fluid coupling slippage.

f. Four planetary gearing systems which provide efficient torque flow through all ranges are incorporated in the MT 654CR transmission.

(1) These planetary systems are controlled by a series of hydraulically actuated clutches.

(2) All planetary gears remain in constant mesh.

g. Only part of the specification data pertinent to the MT 654CR transmission is listed here. Complete detailed design data and ratings are extensive; therefore, the service manual must be consulted for additional information.

(1) Input rpm = 3000 (maximum).

(2) Input horsepower = 300 (maximum).

(3) Input torque = rated 950 foot-pounds.

(4) Rotation = clockwise (viewed from input).

(5) Fluid type = OE/HDO 10 (do not mix).

(6) Fluid capacities = (less external circuits):

(a) Twenty-five quarts with PTO (23 quarts without).

- (b) Drain and refill 19 quarts with PTO and 17 quarts without.
- (7) Filter is integral, located in the sump.
- (8) Weight = (less oil and PTO) 640 lbs.

h. The operational functions of the MT 654CR must begin with the transmission controls located in the cab.

- (1) The shifting lever is mounted in a housing secured to the dash.
- (2) Driving shift positions are identified on a data plate as follows:

- (a) R = Reverse.
- (b) N = Neutral.
- (c) 1-5 = Drive/ fifth gear.
- (d) 1-4 = Fourth gear.
- (e) 1-3 = Third gear.
- (f) 1-2 = Second gear.
- (g) 1 = First gear.

i. Gear Selection Operation

(1) Neutral Position (N). The selector must be in the neutral position before the engine can be started. With the selector in neutral, the transmission is transmitting no torque; therefore, with the parking brake set, the engine can remain in operation without danger of movement even though low clutch is engaged.

NOTE: The engine must be at idle before any shift lever selection is made.

(2) Drive Five (1-5). This selection is most commonly used for normal driving. When the selection is made and the accelerator is depressed, the transmission will automatically upshift through ranges one through five as the appropriate speeds occur. Fifth gear has a ratio of 1.00:1.

(3) Drive Four (1-4). In 1-4 selection, the transmission develops four forward speeds, one through four automatically, as the appropriate

speeds are attained. When the fourth speed range occurs, upshifting ceases and the transmission will hold in fourth gear at a ratio of 1.27:1.

(4) Drive Three (1-3). In this selection, the transmission will develop three forward speeds, one through three automatically, as the appropriate speeds occur. When the third speed range is achieved, the transmission will hold in third gear at a ratio of 1.66:1.

(5) Drive Two (1-2). In this position, two forward speeds are developed as appropriate speed is attained. When this occurs the transmission will hold in second gear at a ratio of 2.21:1.

(6) Drive One (1). In this position, the transmission makes no automatic shift, but will attain and hold first gear range with a ratio of 4.17:1.

(7) Downshifting will take place automatically from fifth gear, to fourth, to third, to second, to first as the speed decreases.

(8) Reverse Gear (R). The vehicle must be at idle and stopped before shifting to reverse gear. Reverse gear ratio is 10.76:1.

NOTE: Shifting to reverse gear while the vehicle is in motion could cause severe damage to the transmission. If the vehicle is to be towed or pushed, you must remember that reverse torque takes place as the wheels try to drive the transmission. This could cause extensive damage to the transmission. Therefore, if the vehicle must be towed or pushed, the transfer must be in the neutral position or the propeller shaft removed. The vehicle cannot be push started.

j. Description of Internal Transmission Components. The illustration on page VII-6 shows the name and location of the internal components of the MT654 Transmission.

## **2. DESCRIPTION OF THE PLANETARY GEAR SYSTEMS AND THE PRINCIPLES OF THEIR OPERATION, TO INCLUDE TORQUE FLOW THROUGH THE SYSTEM AND CLUTCH OPERATIONS**

a. In our introduction lesson we said there are four planetary systems in the Allison MT 654CR transmission. These planetary systems are all spur type gears, as you can see. In the front planetary set you will find that there are six planetary/pinion gears, and only four in the remaining three planetary sets. The MT 654CR and the THM 400 are similar in this respect. Go back for a moment to the film you viewed on planetary systems or sets. Recall there were only three planetary gears in the sets being demonstrated. This is to help you understand that there may be three,

four, six or more, according to what the manufacturer determined to be necessary.

(1) First you will observe a "sun" gear around which a variable number of planetary gears are contained in a carrier. The planetary gears are also free to rotate on shafts within the carrier assembly. The planetary gears are also referred to as "pinion" gears. The difference in the usage "planetary" vs "pinion" gear lies in definition. The term "planetary" implies motion, while "pinion" gear denotes pivotal driving force. This terminology is appropriate in both instances, as you have discovered.

(2) The sun gear, planetary/pinion gears, and carrier assembly, revolve or orbit within a ring gear which determines the orbital dimension. By the interrelation of the pinions, sun gear sizes, and number of teeth, we gain the capacity to vary the speed and delivery of the torque product.

(3) Each component of the planetary system; sun gear, planetary carrier assembly, and ring gear, may either be held in place, idle, or rotate to deliver torque as the requirement might be, by the utilization of various controlling mechanisms such as clutches, which the design will dictate.

(4) Knowing this, it should not be difficult to visualize some of the potential flexibility available to us in the adaptation of this system, when you consider that we have incorporated four planetary systems in our subject transmission, the Allison MT 654CR.

#### b. Operation Principles and Basic Laws of Simple Planetary Gears

(1) The versatility of the planetary gear system is made possible by the basic laws which govern its activities as follows:

(a) When the ring gear is held, and the sun gear is the input torque, the planetary/pinion gears will orbit the sun gear inside the ring gear and the torque will be delivered through the carrier assembly.

(b) If the sun gear is held and the ring gear is the input torque, the planetary/pinion gear will orbit the sun gear and the carrier assembly will deliver the output torque.

(c) With the ring gear held and the carrier assembly as the input torque, the planetary/pinion gears will orbit the sun gear and the sun gear delivers output torque.

(d) If the carrier assembly is the input torque, and the sun gear is held, the planetary/pinion gear will orbit the sun gear causing the ring gear to deliver the output torque.

(e) By holding the carrier assembly with the sun gear as input torque, the planetary/pinion gears will rotate, driving the ring gear which delivers the output torque.

(f) When the ring gear is the input torque and the carrier assembly is held, the planetary gears will rotate, driving the sun gear which delivers output torque.

(g) When any two members are held together, speed and direction are same as input; ratio 1:1.

(h) If the carrier is the:

1 output, underdrive results, or speed decreases.

2 input, overdrive results, or speed increases.

3 held member, output direction is reversed.

(2) As you can see, the planetary gear system can be very versatile.

#### c. Hydraulically Actuated Clutch Assemblies

NOTE: Clutch wear is compensated for by piston travel in all the MT 654CR clutch systems.

(1) There are seven hydraulically actuated clutches in this system which control the torque flow of the transmission; a single-disc, direct drive lockup clutch assembly and six multiple-disc clutch assemblies.

(a) The single-disc lockup clutch assembly consists of a backing plate, a friction disc, and a hydraulically actuated piston which engages the clutch, causing direct drive from the engine to the turbine shaft. This clutch is located in the torque converter.

(b) The six multi-disc clutches consist of a series of alternate rotating and stationary discs which are keyed to the main housing assembly and the planetary system components, facilitating the control of the various torque flow selections of which the transmission is capable. These clutches are also actuated by means of a hydraulic actuated piston, friction disc and a backing plate.

(2) These clutches, when engaged, hold the various components of the planetary gear system or allow torque to be transmitted as required, such as in fourth clutch.

### **3. DESCRIPTION AND OPERATING PRINCIPLES OF THE TRANSMISSION'S HYDRAULIC SYSTEM**

a. Torque Converter. The torque converter is the first component in the power transmission system.

(1) The torque converter was initially designed to facilitate a smooth, friction-free delivery of torque flow from an engine to a transmission or driven assembly. It is, in reality, a fluid clutch or coupling. As a matter of fact, in the early days of its automotive application, it was referred to as fluid drive.

(2) To understand the principles of its design and operation, let's compare it to a simple experiment. If you were to fill a container with water, submerge your hand, and begin to rotate it, slowly at first, then faster and faster, you would notice the water swirling, the centrifugal force causing the water to move away from the center and up the sides of the container leaving a cavity in the center. This rotary fluid current is called a vortex. By utilizing this vortex current flow and directing its force, we can cause what we will call a turbine to rotate.

(3) Engine torque is transmitted by the engine flywheel which is bolted to the torque converter flywheel and pump assembly. The pump, at this point, converts the mechanical effort of the engine to fluid motion.

(4) The torque converter pump directs a high velocity oil flow against the vanes of the converter turbine, causing it to rotate.

(5) As the turbine rotation occurs, the oil flowing through the stator vanes is redirected back against the pump vanes from a different direction, assisting in the pump rotation.

(6) It is the redirection of the oil flow against the pump vanes that enables the torque converter to multiply the input torque.

(7) Torque multiplication is greatest when the pump is rotating at its highest speed. Torque multiplication ceases when the turbine speed is equal to that of the pump, and the converter becomes, in effect, a fluid coupling.

(8) As the turbine rotates, the splined turbine shaft transmits its torque to the transmission forward clutch housing.

(9) Lockup operation. Power is transmitted mechanically through the lockup clutch. Application of the lockup clutch occurs automatically as a function of governor pressure.

b. The Converter Regulator (Pressure Relief) Valve. The torque converter receives its oil through passages around the turbine shaft at main system pressure. In the eventuality of excessive oil pressure build-up in the converter, a spring loaded poppet valve will open, venting the excess fluid to the sump. This valve is located in the front support assembly.

c. The Transmission Oil Cooler Assembly. Heated oil from the converter passes through the water-cooled oil cooler where its temperature is lowered and returns the cooled oil through the lubricating passages in the transmission back to the sump. The oil cooler is located at the right side of the engine.

d. The Oil Pump. It supplies hydraulic fluid under pressure to the entire hydraulic system. The pump is located in the front support housing of the transmission. The pump is gear driven by the torque converter pump housing hub sleeve, and consists of three basic components:

- (1) drive gear,
- (2) driven gear, and
- (3) pump body.

e. The Main Pressure Regulator. It controls the main hydraulic system pressure. The regulator is located in the transmission front support housing.

(1) The flow of fluid under pressure from the pump passes through the main pressure regulator which adjusts the system pressure within the operating limits.

(2) A spring in the valve predetermines main system pressure.

(3) As the pressure builds in the system, the fluid flows through an internal passage into the upper chamber of the valve.

(4) As the pressure reaches the prescribed limit in the upper chamber, it forces the valve downward, overcoming spring tension and opening a passage which permits fluid to flow into the converter circuit. This fluid passes through the converter circuit, through the oil cooler and lubrication regulator, becoming lubrication oil flowing throughout the transmission assembly and returning to the sump.

(5) Integral to the main pressure regulator is the forward regulator, which becomes functional as soon as a forward range is selected by the manual selector valve. A forward gear selection will have a slightly downward

effect on main system pressure. A forward regulator circuit originates at the manual selector valve and terminates at the main pressure regulator valve.

(6) The lockup valve is located in the oil pan. This valve operates by governor pressure assisted by modulator pressure. The lockup relay valve is located in the front support and operates the same as the other relay valves.

f. The Centrifugal (Safety Relief) Valve. There is an additional safeguard in the forward clutch circuit which prevents engine over-speed damage resulting from a reverse torque load. As revolutions per minute increase, centrifugal fluid force inside the forward clutch increases. When this occurs, a spring loaded poppet valve will open, venting the fluid pressure to the sump, disengaging the forward clutch. As the pressure drops, the valve closes again, permitting the forward clutch to reengage. This cycle continues intermittently until the reverse-torque load condition no longer exists and normal driving conditions are resumed.

g. The Governor Valve. It regulates the transmission shifting pressures. The valve is controlled by the centrifugal motion of the governor fly weights as the speed of the transmission output shaft varies. The governor valve is located in the rear cover assembly.

(1) As you can see in the diagram, main system pressure goes directly to the governor valve.

(2) The governor is driven by the output shaft, which obviously varies in speed as forward ranges are selected and movement begins.

(3) As the revolutions per minute increase or decrease, the governor flyweight responds accordingly, either outward farther and farther as the speed increases or inwardly as the speed decreases. This flyweight activity operates the governor valve, proportionately adjusting the main pressure more or less as it enters the shifting circuits.

(4) The required shifting pressures, which differ in each range, are predetermined by spring tension in each specific shift selector valve.

(5) Included in the governor circuit is an accumulator. The governor accumulator stores a volume of fluid under pressure to compensate for any sudden change in governor speed. Were this to occur, the stored pressurized fluid would be injected into the governor circuit instantaneously, maintaining governor pressure.

(6) The accumulator has a calibrated spring and plug. The spring is calibrated to function in the circuit it is assigned, and will work only in that circuit.

#### h. Modulator Units

(1) The M939 Series vehicles use the mechanical type modulator actuator with the Allison MT 654CR automatic transmission.

(2) The modulator unit works in conjunction with the governor to provide prompt, smooth shifting cycles at lower throttle positions. A hydraulic valve controlled by the mechanical position of the adjustable throttle linkage determines the modulator valve pressure balance with the governor pressure to effect the shift cycle. The modulator unit is located in the lower left side of the transmission housing.

(a) In effect, modulator pressure assists the governor pressure to facilitate a smoother, earlier shift cycle.

(b) At idle throttle position, modulator assistance is maximum, decreasing as the throttle is opened.

(c) There is no modulator assistance available at full throttle.

(d) In the event of rapid stop or deceleration, the modulator retards the downshift cycle, preventing shift shock.

i. The Manual Shift Selector Valve. This is the control used by the operator to select reverse, neutral, and all five forward speed ranges. The transmission will respond and hold at any range selected.

(1) In neutral, main pressure is available and standing by. It leaves the selector valve only to return to the main pressure regulator.

(2) The D-5 or 1-5 being underlined indicates selector position. This selection is most commonly used in the automatic transmission for normal driving. In this selection there is no hold and the transmission may shift automatically through all forward ranges. As you can see, fluid is now traveling from the selector valve to the forward clutch; at this time there is no fluid going to the hold regulator.

(3) Let's move to the right side of this frame. We see the selector valve is moved to a D-4 or 1-4 position. This selection is used to facilitate a hold allowing the transmission to shift automatically from 1 through 4. Also in this frame you can see that fluid is now going to the

hold regulator and returning from the hold regulator to the selector valve, filling a chamber and a passage to the 4-5 shift signal valve.

(4) At the left of this frame you will see the selector is in the D-3 or 1-3 position and the passage to the 3-4 shift signal valve now has fluid passing through it. This selection will facilitate a hold, allowing the transmission to shift from 1 through 3 automatically and holding there. No automatic shifting will occur beyond the selection. Hold regulator fluid is traveling to the 4-5, 3-4 shift signal valves.

(5) Looking to the right of the frame, we now have a selection of D-2 or 1-2. This selection works similar with the exception that the transmission will only shift from 1st to 2nd and hold. Fluid from the hold regulator valve is now traveling to the 4-5, 3-4, 2-3 shift signal valves.

(6) In the D-1 or 1 selection, there is no automatic shift, the transmission will hold in 1st gear, and as you can see, all hold passages are filled with fluid from the hold regulator valve, 4-5, 3-4, 2-3 and 1-2 shift signal valves.

(7) This vehicle will not shift out of 1st gear as long as engine and transmission governors are working correctly. The only way to upshift the transmission while in this selection is to allow the wheels to drive the transmission at a higher rpm than the engine governor is set.

(8) In all the hold positions except for D-1 or 1, the transmission will automatically upshift to the hold selected and automatically downshift.

(9) To the right of this frame you will see the selector has been moved to the reverse position. At this time, note the change in fluid direction; main fluid pressure is coming from the main pressure regulator and going direct to the reverse signal switch, 4-5 relay valve and to fourth clutch and trimmer.

(10) The hold regulator valve receives main pressure which then becomes a regulated reduced pressure to accommodate the hold circuit. In this hold position, D-2 or 1-2, we see the selector valve is allowing main fluid pressure to pass to the hold regulator valve and on to the 4-5, 3-4, 2-3 shift signal valves. At the 2-3 signal valve we can see the shift modulator valve and the shift signal valve have been separated by regulator hold pressure. The hold pressure will be higher than the governor pressure. Therefore, governor pressure is the lowest and cannot overcome hold pressure and shifting beyond the selection cannot be accomplished.

j. Shift Signal Valves. There are five shift signal valves in the

hydraulic system. These signal valves first receive a fluid pressure signal manually from the shift selector and automatically thereafter from governor oil pressure. Fluid pressure from the shift signal valves is subsequently directed to the appropriate relay valves at the precise pressure required to effect the desired shift, up or down. The shift signal valves are located in the transmission valve body at the bottom of the transmission housing.

k. Relay Valves. The relay valves are distributing valves which receive a signal pressure from the shift signal valves and direct oil to the appropriate clutches providing the desired planetary activity. As the transmission shifts up or down, the relay valves also relieve the pressure back to sump in the preceding sequential clutch assembly. For example, when the transmission shifts from first to second gear, the relay valve will vent the fluid from the first clutch as the shift cycle is completed.

(1) When the main system pressure is received, the relay valve is actuated, directing main system pressure to the corresponding clutch assembly.

(2) As the clutch actuation takes place, the relay valve simultaneously relieves the actuating pressure against the piston of the preceding clutch assembly.

(3) This cycle is repeated through each of the subsequent gear shift cycles.

l. Trimmer Regulator Valve. The trimmer regulator valve reduces main system pressure to the pressure range(s) determined by the modulator unit, to accelerate the shifting sequence. The modulated pressure from the trimmer regulator valve is directed to the low, first, and second clutch trimmer valves.

m. Trimmer Valves. There are five trimmer valves in the system. A trimmer valve is installed in the pressure passage to each of the clutches.

(1) Each trimmer valve is pressure calibrated proportionately to the individual clutch it serves.

(2) As the main pressure from the relay valve impacts in the clutch circuit, the trimmer valve action cushions the impact, facilitating a smooth clutch application.

(3) Included in the trimmer regulator circuit is an accumulator. The trimmer accumulator works the same as the governor accumulator which we have just discussed, and like the governor accumulator, the trimmer accumulator will work only in the circuit it is assigned.

(4) There are two accumulators in the hydraulic system, as we have seen, both accumulators doing the same job in the circuit they are assigned.

n. Priority Valve. It assures main system pressure is always available on demand to the relay valves for clutch application during automatic shifting cycles by storing fluid under pressure.

(1) Without a priority valve, the fluid volume requirement during actuation of a clutch is large enough to cause a pressure drop in the system, resulting in the elimination of the automatic shifting functions.

(2) The volume of oil required to actuate a clutch assembly is larger than the pump can sustain momentarily and the necessary hydraulic controls in the rest of the system would be neutralized and automatic shifting would be lost.

#### **4. SCOPE OF INTERMEDIATE MAINTENANCE AUTHORITY/RESPONSIBILITY RELATIVE TO THE TRANSMISSION**

a. The Intermediate Maintenance Mechanic will be Required to Perform the Following Tasks:

- (1) disassemble the transmission into subassemblies,
- (2) test and repair the transmission subassemblies, and
- (3) assemble the transmission from serviceable subassemblies.

b. The Intermediate Maintenance Mechanic will Also be Required to Diagnose Malfunctions

#### **5. PROCEDURAL STEPS USED TO DISASSEMBLE, REPAIR AND REASSEMBLE THE ALLISON MT 654CR AUTOMATIC TRANSMISSION**

a. Detailed instructions for the MT 654CR transmission are contained in the manuals that were issued to you at the beginning of this block of instruction. Follow those instructions carefully to effect those disassembly, repair and reassembly procedures on the training aid transmission to which you have been assigned.

b. Have the instructor assigned to your station check your work at each point designated in this student handout.

c. Refer to TM 9-2320-272-34-1 for the procedures used to perform tasks listed. Use the index to locate the instructions in the manual and read the instructions carefully before performing each task.

d. Disassemble the transmission into subassemblies.

- (1) Remove the torque converter.
- (2) Remove the oil pan and oil filter assembly.
- (3) Remove the control valve assembly.  
(Place on bench, with machined side facing up.)
- (4) Remove the oil pump and front support assembly.  
(Keep oil pump off its side.)
- (5) Remove the forward clutch and turbine shaft assembly.  
(Do not lay on its side.)
- (6) Remove the fourth clutch assembly and third clutch assembly.
- (7) Remove the center support.
- (8) Remove the gear unit and main shaft.  
(Place in hole on work bench.)
- (9) Remove the second clutch assembly.
- (10) Remove the first clutch assembly.
- (11) Remove the governor, rear housing and output shaft assembly.  
(Remove as one unit and place on work bench.)
- (12) Remove the low planetary ring gear, hub and clutch assembly.  
(Remove as a unit.)
- (13) Remove the adapter housing.

STOP! Have instructor initial.

e. Make sure the following transmission subassemblies are serviceable through inspection, repair, or replacement:

- (1) Torque converter.

STOP! Have instructor initial.

- (2) Oil pump and front support.

STOP! Have instructor initial.

(3) Forward clutch and turbine shaft.

STOP! Have instructor initial.

(4) Fourth clutch.

STOP! Have instructor initial.

(5) Center support and second and third clutch packs.

STOP! Have instructor initial.

(6) Gear unit and main shaft.

STOP! Have instructor initial.

(7) Housing assembly.

STOP! Have instructor initial.

(8) Adapter housing assembly and first clutch components.

STOP! Have instructor initial.

(9) Rear cover assembly and low clutch components.

STOP! Have instructor initial.

(10) Modulated lock-up valve, low trimmer and low shift signal valve.

STOP! Have instructor initial.

(11) Control valve assembly.

STOP! Have instructor initial. \_\_\_\_\_.

(12) Procedures for testing and adjusting the control valve and associated valves.

(a) Installation of the Control Valve Assembly on the Test Stand

1 The control valve and associated valves will be installed onto the valve stand adapter in the same manner as they would be installed on the transmission.

\_\_\_\_\_ 2 When installing the valve body onto the adapter plate, torque the valve body bolts to 8 to 12 foot-pounds. Use caution to start in the center and draw the bolts down by moving away from the center. Torquing from one side to the other will cause the hold regulator valve to stick in its bore.

\_\_\_\_\_ 3 Close the cover of the test stand before turning on the power.

(b) Preparing Test Stand for Operation

\_\_\_\_\_ 1 Switch on the power at the disconnect box.

\_\_\_\_\_ 2 Turn on the oil temperature switch and allow the oil to warm to 100 to 180 degrees Fahrenheit.

\_\_\_\_\_ 3 Turn on the tachometer switch.

\_\_\_\_\_ 4 Turn the governor drive ratio switch to the 1:1 position.

\_\_\_\_\_ 5 Close the cover door before starting the tester.

(c) Governor Test Requirements, Procedures and Adjustments

\_\_\_\_\_ 1 Main pressure must be adjusted to 150 psi, unless otherwise noted in the Detroit Diesel Allison service letter.

\_\_\_\_\_ 2 Oil temperature must be 100 degrees Fahrenheit minimum and stable.

\_\_\_\_\_ 3 The valve body must be mounted on the adapter.

\_\_\_\_\_ 4 The drive ratio selector switch must be set at the 1:1 position.

\_\_\_\_\_ 5 The governor assembly must be installed into the proper mounting location.

\_\_\_\_\_ 6 The governor will be tested at four speeds. It will be tested at 440, 800, 1500, and 2200 rpm. This is necessary to make sure all of the governor assembly parts are functioning. Increase the governor assembly rpm by rotating the knob marked "SPEED CONTROL" clockwise. The governor assembly should output the pressure listed in the Detroit Diesel Allison service information letter.

\_\_\_\_\_ 7 This information is in your student handout. No adjustment is possible; however, the internal valve may be removed and cleaned to ensure free operation. If it does not put out the pressure listed in the Detroit Diesel Allison service information letter, replace the governor.

(d) Modulator Pressure Test Requirements, Procedures, and Adjustments

\_\_\_\_\_ 1 Main pressure must be adjusted to 150 psi.

\_\_\_\_\_ 2 Oil temperature must be 100 degrees Fahrenheit minimum and stable.

\_\_\_\_\_ 3 Select "FULL THROTTLE" with the modulator control and note 0 to 2 psi modulator pressure on the modulator gage.

\_\_\_\_\_ 4 Select "CLOSED THROTTLE" with the modulator control and note the pressure listed in the Detroit Diesel Allison service letter. This information is in your student handout.

\_\_\_\_\_ 5 Rotating the spring adjusting ring on the modulator valve spring clockwise will increase modulator pressure until the most shallow notch on the ring has been reached. Counterclockwise rotation will decrease modulator pressure until the deepest notch in the ring has been reached.

\_\_\_\_\_ 6 Modulator pressure must be correct at both idle and full throttle.

(e) Hold Regulator Test Requirements, Procedures, and Adjustments

\_\_\_\_\_ 1 Oil temperature must be 100 degrees Fahrenheit minimum and stable.

\_\_\_\_\_ 2 Main pressure must be 150 psi.

\_\_\_\_\_ 3 A hold selection such as "DRIVE 1", or "DRIVE 2" must be established.

\_\_\_\_\_ 4 Notice the hold regulated pressure gauge. Its reading should match the required pressure from the charts listed in the Detroit Diesel Allison service information letter. This information is in your student handout.

5 Adjust the pressure by rotating the spring adjusting ring clockwise to increase hold regulated pressure until the most shallow notch in the ring has been reached. Rotating the spring adjuster ring counterclockwise will reduce hold regulator pressure until the deepest notch in the adjuster ring has been reached.

(f) Shift Point Test Requirements, Procedures, and Adjustment.  
Complete shift point test procedures will not be used at this time. Shift point information can be found in the Allison MT 654CR service manual. We will use the procedure for full throttle upshift.

1 Main pressure should be 150 psi.

2 Oil temperature should be 100 degrees Fahrenheit minimum and stable.

3 Use only the governor assembly that will be installed with the valve body.

4 Set the drive ratio selector switch to the 1.3:1 position.

5 Select "FULL THROTTLE" with the modulator control and notice 0 to 2 psi modulator pressure. Failure to achieve 0 to 2 psi requires adjustment per the instructions contained in the service information letter. Place range selector in "DRIVE". Increase output shaft rpm slowly and note the rpm at each shift event. In order to achieve accurate shift point readings, it is imperative that rpm be increased slowly and performed several times. Compare rpm noted with the desired rpm shift point tables in the Detroit Diesel Allison service letter. Adjust the shift signal valve ring until each shift event occurs within the desired rpm tolerance.

6 Turning the shift signal valve spring adjuster ring clockwise will raise the shift point until the most shallow notch in the ring has been reached. Turning the shift signal valve spring adjuster ring counterclockwise lowers the shift point until the deepest notch is reached. Sometimes another governor having slightly different pressure characteristics, within specifications, may correct minor shift schedule discrepancies.

(g) Trimmer Regulator and Reverse Function, Requirements, and Procedures

1 Oil temperature should be 100 degrees Fahrenheit minimum and stable.

2 Main pressure should be 150 psi.

3 This is only a function test, not a specific pressure test. Achieve a downshift into a range using a trimmer valve affected by trimmer regulator pressure, both at idle throttle and at full throttle. As the clutch feed passage and clutch gauge charge, the rise of pressure is interpreted as the trimmer valve opens and closes. This hesitation or stagger in pressure rise indicates the initial clutch pressure. The initial clutch pressure should be higher during a full throttle downshift than it is during an idle throttle downshift. There is no adjustment.

4 Shift to REVERSE and note full main pressure on low and fourth clutch gauges.

(h) With all tests completed, the valve body would be removed from the test stand and placed in a clean area. Here at the school we will leave the valve body attached to the test stand.

STOP! Have instructor initial.

f. Assemble the Transmission from Serviceable Components

- (1) Select the center support snap ring.

STOP! Have instructor initial.

- (2) Establish second clutch clearance
- (3) Establish low clutch clearance

STOP! Have instructor initial.

- (4) Install the adapter housing.
- (5) Install the low planetary ring gear, hub and clutch assembly.

\_\_\_\_\_ STOP! Have instructor initial.

- \_\_\_\_\_ (6) Install the rear cover and output shaft assembly and governor.

- (7) Install the first clutch assembly.

\_\_\_\_\_ STOP! Have instructor initial.

- \_\_\_\_\_ (8) Install the gear unit and main shaft.

- (9) Install the second clutch assembly.

\_\_\_\_\_ STOP! Have instructor initial.

\_\_\_\_\_ (10) Install the center support.

\_\_\_\_\_ STOP! Have instructor initial.

\_\_\_\_\_ (11) Install the fourth clutch and third clutch assemblies.

\_\_\_\_\_ STOP! Have instructor initial.

(12) Install the forward clutch and turbine shaft assembly.

STOP! Have instructor initial.

(13) Install the oil pump and front support.

STOP! Have instructor initial.

(14) Install the control valve assembly.

STOP! Have instructor initial.

(15) Install the oil pan and oil filter assembly.

STOP! Have instructor initial.

(16) Install the torque converter.

STOP! Have instructor initial.

#### GOVERNOR PRESSURE SCHEDULE

The governor schedule testing requires main pressure to be 150 psi minimum and oil temperature to be 100 degrees Fahrenheit  $\pm$  10 degrees.

The table below provides PSI specifications for governor output pressure at transmission output shaft speed.

GOVERNOR ASSEMBLIES	<u>CODE NUMBER</u>	440 <u>RPM</u>	800 <u>RPM</u>	1500 <u>RPM</u>	2200 <u>RPM</u>
6881466	460 (Old Code 91)	7-10	21-5-24.5	38.0-42.5	55.5-63.0
6885570	461 (Old Code 54)	9-13	38-42	64.0-70.0	103-112
6885571	462 (Old Code 52)	8.5-11.5	27.5-30.5	54.5-61.0	82.6-91

Adjustment - No adjustment is possible. However, the internal valve may be removed and cleaned to insure free operation.

#### MODULATOR PRESSURE CHART

<u>AT-500 (ALL MODELS)</u>	<u>50 TO 53 PSI</u>	
<u>CLT-600 (ALL MODELS)</u>	<u>50 TO 53 PSI</u>	
	50 TO 53 PSI	
<u>MT-600 MT-643/653</u>	<u>26 TO 28 PSI</u>	<u>SMOOTH SHIFT</u>
<u>MT-644</u>	<u>26 TO 28 PSI</u>	
	50 TO 53 PSI	
<u>MT-654CR</u>	<u>26 TO 28 PSI</u>	<u>SMOOTH SHIFT</u>
<u>MT-654CR (2100-COACH)</u>	<u>28 TO 30 PSI</u>	
<u>V-730 2100</u>	<u>45 TO 49 PSI</u>	
<u>ALTERNATE</u>	<u>33 TO 36 PSI</u>	
<u>OPTIONAL</u>	<u>26 TO 29 PSI</u>	
<u>HT-700 AND CL(B)T-700</u>		*
* SEE THE PARTS CATALOG FOR THE MODULATOR SPRING PART NUMBER - IF THE SPRING PART NUMBER IS <u>6833934 (SOLID WHITE WITH</u> <u>ORANGE STRIPES)</u>		
	<u>50 TO 53 PSI</u>	
IF THE SPRING PART NUMBER IS 6838077		

(SOLID YELLOW)	26 TO 28 PSI
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IF THE SPRING PART NUMBER IS 6838519	
(BLUE STRIPE)	35 TO 37 PSI
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IF THE SPRING PART NUMBER IS 6880980	
(SOLID BLUE WITH RED STRIPES)	42 TO 44 PSI
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#### HOLD REGULATOR ADJUSTMENT CHART

##### MT-654CR

\*SEE THE PARTS CATALOG FOR THE HOLD REGULATOR SPRING PART NUMBER

IF SPRING PART NUMBER IS 6836976	
(SOLID WHITE W/YELLOW STRIPE)	47 TO 49 PSI
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IF SPRING PART NUMBER IS 6836977	
(SOLID ORANGE)	55 TO 57 PSI
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IF SPRING PART NUMBER IS 6839199	
(SOLID BLUE W/YELLOW STRIPE)	58 TO 60 PSI
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#### REFERENCES:

TM 9-2320-272-34-1  
Allison MT 654CR Service Manual  
Aidco 250 Operator's Manual